Field Guide for Detection and Identification of Laminated Root Rot in Rehabilitation Areas

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ECONOMIC & REGIONAL DEVELOPMENT AGREEMENT

Canada

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FIELD GUIDE FOR DETECTION AND IDENTIFICATION OF LAMINATED ROOT ROT IN REHABILITATION AREAS

OBJECTIVE

Laminated root rot, caused by the fungus *Phellinus weirii*, spreads by root contact between healthy trees and infected stumps or trees. The hazard potential posed by laminated root rot can vary greatly between strata, depending on stand composition, time since last harvest, and soil moisture regime and texture.

The following detection methodology, identifying features, and background information for laminated root rot are applicable to those areas where non-susceptible coniferous species and/or deciduous trees form a significant component of the stand and where the first-growth stand consisted of susceptible species. These sites often have a clumped species distribution, with areas of susceptible Douglas-fir, true fir or western hemlock interspersed with non-susceptible species. Such areas must be rehabilitated since they are understocked for the more commercially desirable species.

Disease and volume losses increase from one rotation to the next unless appropriate management is implemented. Post-harvest treatments are the least costly and most biologically effective strategy for limiting further losses. Thus, knowledge of laminated root rot levels and the potential for further spread should be acquired prior to implementation of the prescribed site preparation treatments and planting plans on these sites.

A. DETECTION METHODOLOGY

Use the following methodology as outlined:

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1. Stratify the selected rehabilitation area by tree cover. Use aerial photos, biogeoclimatic and forest cover maps, and available history records.

2. Determine the laminated root rot hazard rating and survey priority for each stratum following the procedure on **Form I: Decision Guidelines for Rehabilitation Area Laminated Root Rot Surveys**. Decide on the survey type (pre- or post-harvest) based upon the 41 year age criterion.

3. For those strata requiring a root rot survey, transfer the data from **Form I** to **Form II: Site Root Rot Assessment Information Sheet**. Strata designated as very low to nil should not be surveyed for laminated root rot.

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Field

4. Conduct either a pre- or post-harvest transect survey, whichever is applicable. For pre-harvest surveys, look for and record disease symptoms only in second-growth trees and windfall. During post-harvest surveys, look for and record disease symptoms in both the first- and second-growth stumps.

5. Using a hip-chain, establish a base line and place initial survey lines 50 m apart. Look for and record disease symptoms in stumps or trees located up to 5 m either side of the line for both pre- and post- harvest surveys.

6. Determine disease intercept lengths with a hip-chain for the pre- or post-harvest survey. For pre-harvest surveys, use distance from the last healthy tree intercepted to the first healthy tree encountered beyond an infection centre as the infection length. Infected trees must be adjacent to these healthy trees. For post-harvest surveys, infection length is calculated to be the distance between the first and last infected stump encountered in an infection centre, plus 5 m on each end. Record a 10 m infection length for single infected stumps. Ignore small clumps of healthy appearing trees within infection centres.

7. Use metric grid field sheets to record all intercept lengths and to map all infected stumps, trees, or stratum boundaries. Summarize disease intercept and transect lengths per stratum on **Form II**.

8. Total the disease intercept and transect lengths and determine the disease incidence of each stratum using the following formula.

$$\textbf{Disease Incidence (\%)} = \frac{\textbf{Total Disease Intercept Length (m)}}{\textbf{Total Transect Length (m)}} \times 100$$

9. If the disease incidence is greater than 10% in a given stratum, place additional survey lines 25 m apart along the baseline to map the maximum amount of disease.

10. Summarize root rot incidence and risk rating for each stratum on **Form II**. Use these data for any future decisions on site treatment.

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11. Determine the appropriate site treatment required, if any, using the data obtained above and F.S. Int. Rep. P-V-6: *Guidelines for Detection and Treatment of Laminated Root Rot in the Vancouver Forest Region* (J.D. Beale, 1987).

B. IDENTIFICATION

Use the following features to identify laminated root rot during pre- or post-harvest surveys.

Pre-Harvest Surveys:

Infected trees will exhibit one or more of the following symptoms: thin chlorotic crown with reduced leader growth; distress cone crop; windfall showing characteristic "root balls" (Figs. 1 and 2). Mature trees may not exhibit the same degree of distress cone crop as younger infected trees in disease centres. Examine the root ends of windfall and the exterior portions of the root collar on standing suspect trees for the presence of pathogen-specific symptoms (as described under post-harvest surveys).

Fig. 1 Thin chlorotic crowns with reduced leader growth and distress cone crops.

Fig. 2 Windfall with characteristic rotted-off roots.

Post-Harvest Surveys:

Investigate first and second-growth stumps for the presence of infection columns (Fig. 3). Examine any infection columns you locate for the following pathogen- specific symptoms: lamination following the annual rings, canoe-shaped pits 1 to 3 mm long; and brown tufts of setaceous hyphae (Figs. 4 and 5). The latter can be seen with a hand lens.

Remove some of the soil around the root collar and main lateral roots of several infected stumps in large infection centres. Check for white to mauve ectotrophic mycelium on the surface of root bark, and brown crust-like ectotrophic mycelium on callused-over root ends or on the root collar (Fig. 6). Ectotrophic mycelium is characteristic of laminated root rot, but may not always be present.

Record the occurence of any ectotrophic mycelium since this is probably the most infective form of the pathogen. Incipient decay, characterized by areas of red-stained wood in the stump, may or may not be present as this disappears within two or three weeks after harvest.

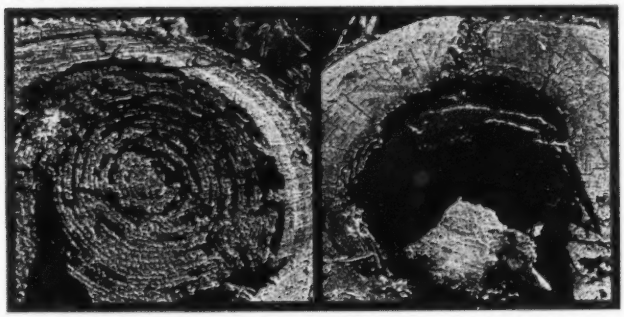


Fig. 3 Infection columns in second-growth stumps, incipient (left) and advanced (right).

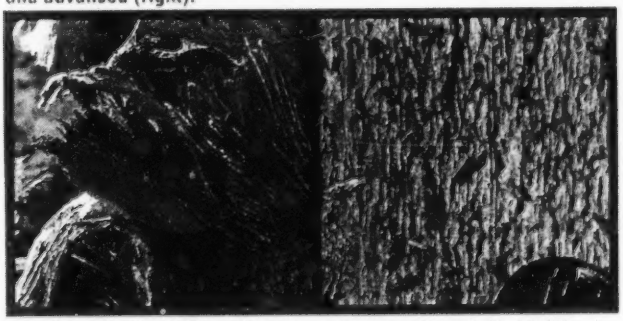


Fig. 4 Lamination (left) and close-up of canoe-shaped pits (right) .

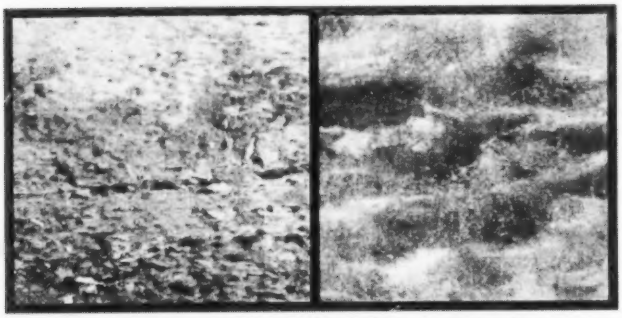


Fig. 5 Brown setaceous hyphae on infected wood, approx. lifesize (left), and hyphae magnified approx. 25X (right).

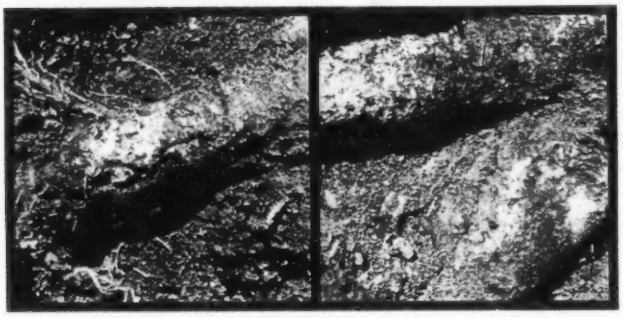


Fig. 6 Ectotrophic mycelium on exterior of roots near root-collar.

C. FACTORS AFFECTING DISEASE INCIDENCE AND SPREAD

The following is background information on three major factors that affect laminated root rot incidence and spread:

Stand Composition

Western red cedar (Cw, coastal) and all deciduous species (D,Ep,Ac,Mb) are not susceptible to laminated root rot. Other coniferous species are infected to a varying extent; Douglas-fir (Fd) and true fir (Bg, Ba) are the most susceptible (Fig.7). The risk of laminated root rot re-infection increases with increasing proportions of susceptible species in the second-growth stand (See **Form I: Decision Guidelines for Coastal Rehabilitation Area Laminated Root Rot Surveys**)

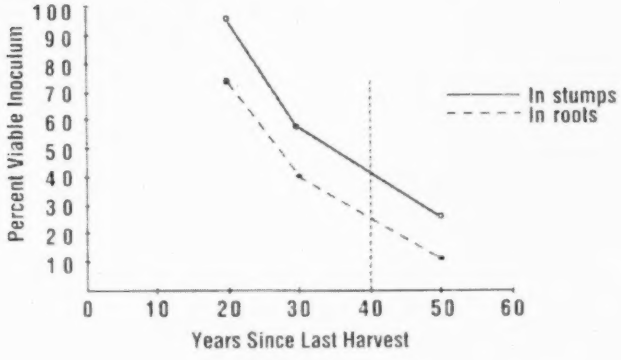
Fig. 7 Species susceptibility to laminated root rot.

Species	Fd,Bg,Ba	Hw	Pl,Pw	Cw,D,Ep,Ac,Mb
Susceptibility	High	Mod	Low	Very low to immune

Time Since Last Harvest

The pathogen is slowly supplanted from host material by other competing soil organisms unless a new host becomes available:

Fig. 8 Laminated root rot decay curve.

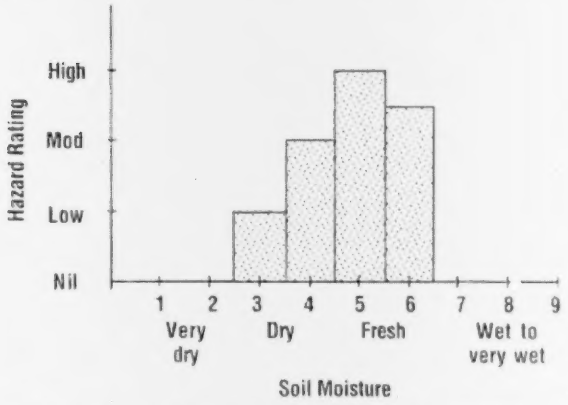


The extent of laminated root rot in first-growth stumps is reduced to approximately 0.5 m around the root collar during the 40 year period since harvest. The threat of re-infection from these first-growth stumps is virtually non-existent by this time. Thus, strata consisting of cedar and/or deciduous species which are more than 40 years old have a low or nil root rot hazard rating if second-growth susceptible species are not present to favour further spread.

Soil Moisture

Survival and spread of laminated root rot is greatest under dry to fresh soil moisture conditions:

Fig. 9. Laminated root rot hazard with respect to soil moisture.



Poorly drained areas, or areas with thick clay soils, are not favourable to this disease. To date, site nutrient regime has not been linked to the incidence and spread of the pathogen.

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